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(54) On-line state resumption in a printer

(57) A printer comprises receiving means (103) for receiving data representing print data and control commands, respectively, from a host device (102); a buffer (104, 107) for storing the received print data; and a printing unit (109, 110) for printing based on the data stored in said buffer. Selection means (105, 108) are provided for preselecting one out of a plurality of resumption operations to be performed when the printer resumes operation upon recovering from an off-line state, said selection means being responsive to a first predetermined one of said control commands. A controller (105) performs the preselected resumption operation when the printer resumes operation upon recovery from the off-line state.

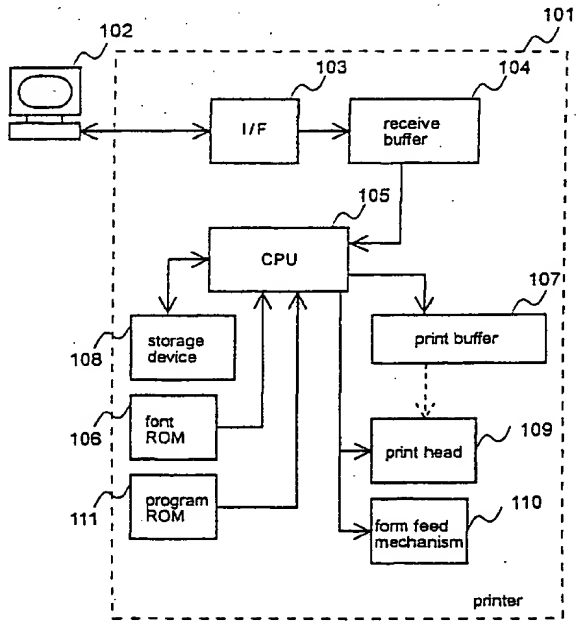

FIG. 1

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can resume operation once the paper jam is removed.

(c) Overheated print head, resulting from printing continuously for an extended period of time.

When the print head overheats, print head damage can occur and print quality deteriorates. The printer therefore enters the off-line state until the print head temperature drops, and then resumes operation.

(d) The user manually sets the printer off-line

This happens, for example, when the user presses an off-line switch on the operating panel of the printer, or opens the printer cover.

[0014] It should be noted that none of these off-line conditions necessarily occurs between forms, i.e., after printing of one form or sheet has been completed and before printing of the next form or sheet is started. In most case the printer will go off-line while just being in the process of printing a form/sheet.

[0015] Some known printers resume operation with reprinting the whole page during which the problem causing the printer to enter the off-line state occurred. Such reprinting of the whole page is not always desirable. For example, in a printing operation in which a sales receipt, coupon and warranty are sequentially printed in one transaction, it is preferable to have reprinted necessary pages in accordance with how many pages jammed. Other current printers typically resume operation by continuing to process the data remaining in the receive buffer 104 or print buffer 107. Particularly when the cause of the off-line state was a paper jam or depletion of the paper supply during printing, this usually means that the part of the information printed before printer goes off-line is on one piece of paper, and the remaining information is printed on new paper after printing is resumed. More specifically, instead of one complete receipt two unusable partial receipts are printed. This is a waste of paper and lowers the efficiency of the printing process.

[0016] This does not happen, however, when the printer is turned off and then turned on again, or when a printer reset operation is performed, after the printer resumed operation because in those two cases the receive buffer and the print buffer are cleared. The problem in this case is that the printer definitions stored in the printer are also reset.

[0017] There is, therefore, a need for the ability to change what is called herein the "resumption operation", i.e., the process or function performed by the printer when it resumes operation, in accordance with what printing operation the host wants the printer to perform.

[0018] To meet the above-described need, an object of the present invention is to provide a printer capable of resuming operation upon recovery from the off-line state without printing a wasteful partial receipt and while retaining the printer definitions stored in printer memory. Another object of the present invention is to provide a control method for such printer and an information storage medium carrying, in machine-readable form, a program for implementing the control method.

[0019] These objects are achieved with a printer as claimed in claim 1 and a method as claimed in claim 7, respectively. Preferred embodiments are subject-matter of the dependent claims.

[0020] The present invention provides a printer in which the resumption operation to be performed upon recovery from the off-line state can be preselected among a plurality of predefined different resumption operations. It is therefore possible to preselect among such resumption operations as continuing the printing process, printing from the beginning of a line that was being printed when the printer went off-line, in the case of a so-called page mode printer, printing from the beginning of the printing area that was being printed when the printer went off-line, etc..

[0021] According to another aspect of the invention, an information processing device for sending print data or commands to a printer to which it is connected for controlling the printer comprises: a transmitter which sends a command telling the printer what resumption operation to perform when the printer resumes operation from an off-line state; a receiver which receives from the printer notification concerning the result of a resumption operation following an off-line state; and re-sending means which resends print data or commands when the receiver receives notification from the printer that the resume operation could not be successfully completed.

[0022] According to this aspect of the present invention, it is possible to achieve the desired print results when the resumption operation to be performed by the printer after an off-line state fails by resending the print data from a host computer or other information processing device.

[0023] The present invention can also be provided as a control method for an information processing device. The control method in this case achieves the same operation and benefits as described above.

[0024] An information processing device control method according to the present invention can also be provided as a control program to be run by the controller of the information processing device. This control program can be supplied using a recording medium to which the control program is recorded. The control program can also be transferred via the Internet or other computer network, for example, for recording by the user to a recording medium accessible to the user's computer or printing apparatus.

[0025] These and other objects and features of the present invention will be readily understood from the following detailed description taken in conjunction with preferred embodiments thereof with reference to the accompanying drawings, in which like parts are designated by like reference numerals and in which:

mand *ESC A n m*. A respective storage area is provided for each off-line cause *n*, and each of these storage areas has the capacity for storing the value of the parameter *m* that represents a respective preselected resumption operation. In the present embodiment, for example, there are three such storage areas because there are three different causes (n = 1, 2, 3), and each storage area comprises 2 bits because the maximum value of the parameter *m* is $m = 4$. A total storage area of 6 bits is therefore required.

[0036] It will be obvious that the required size or capacity of the total storage area depends on the number of off-line state causes declared and the number of resumption operations among which to select. Considering simply the convenience of access by the CPU 105, each storage area could also be one byte or word. It is also possible to use a method in which the address of a specific procedure required to perform a desired process is stored, or some other type of information is stored that has a known correlation to the type of resumption operation to be performed.

[0037] The basic printer operations are described next. The following processes are performed by the printer 101.

(a) Data sent from host 102 is stored in receive buffer 104.

(b) Data buffered in receive buffer 104 is interpreted; print data is generated in print buffer 107 and printed.

(c) If there is a cause for the off-line state, the printer enters the off-line state and, after recovery, performs a resumption operation.

[0038] Referring next to Fig. 2, the process (a) for storing data received from the host 102 in receive buffer 104 is described below.

(1) The printer waits for data to be sent from the host 102 (S201).

(2) Received data is added to the end of data already stored in receive buffer 104, if any (S202).

(3) It is detected (S203) whether receive buffer 104 is full. If it is not full, the procedure loops back to the first step (S201).

(4) If step S203 detects receive buffer 104 to be full, no further data is received until receive buffer 104 is at least partially emptied, whereupon the procedure loops back to the first step (S201).

[0039] Note that the procedure shown in Fig. 2 can be modified to loop from step S204 to S203 until receive buffer 104 is ready to receive new data. However, by entering a standby state in step S204 and allowing control to pass to another process, the processing capacity of the CPU 105 can be used more efficiently. Note that it is assumed below that a standby state includes allowing control to pass to another process.

[0040] The process whereby the data stored in receive buffer 104 is interpreted and print data is generated in print buffer 107 and then printed, is described next with reference to the flow chart in Fig. 3.

(1) In step S301 it is detected whether there is any data in receive buffer 104. If not, the printer enters a standby state. If there is data, the control advances to the next step S302.

(2) In step S302 it is checked whether the data in receive buffer 104 is a character code (S302).

(3) If it is a character code, the font definition for that character code is read from the font ROM 106 (S303) and corresponding print data is generated in print buffer 107 (S304) whereupon the control passes to the process (8) below.

(4) If, in step S302, it is found that the data in receive buffer 104 is not a character code, the data must represent a control command and the command type is determined in step S305.

(5) If step S305 reveals the command is the *ESC A* command specifying the resumption operation to be performed, the control passes to the process (7) below.

(6) If step S305 detects any other type of command, the corresponding process is performed (S306), and the control passes on to the process (8) below.

(7) Parameter *n* is detected, and parameter *m* is stored in the appropriate parameter *n* storage area to define the resumption operation to be performed for the off-line state cause (S307) represented by parameter n.

(8) The receive buffer 104 is refreshed (S308). This increases available memory in the receive buffer 104 by an amount equal to the data processed either in steps S303 and S304 or in step S306.

(9) In step S309 it is then checked whether print buffer 107 is full. If not, the procedure loops back to step S301.

(10) If print buffer 107 is full, print head 109 is driven for the printing process (S310), the print buffer 107 is cleared (S311), and the control loops back to step S301. The printer may be caused to enter the off-line state during the printing process (S310), in

(6) When this procedure ends, the control passes back to the printing process, thereby enabling printing to resume with the data immediately following the marker in receive buffer 104.

[0046] It will be obvious that a marker can be set at the beginning of each receipt to be printed, by sending a set marker command *(ESC B)* before sending the print data for a respective receipt. By thus setting a marker at the beginning of each receipt, it is possible to return to the marker and resume printing from the beginning of a receipt when the printer resumes operation upon recovering from the off-line state that it had entered for some reason while printing that receipt.

[0047] In this manner it can be avoided that only the remaining unprinted part of the receipt it printed; instead, printing of the entire receipt from the beginning is repeated. As a result, a complete receipt can be printed on a single form.

[0048] While using only one marker is considered in the above preferred embodiment of the invention, it will be obvious that plural markers can be set. The marker pointer and marker definition data storage area must be increased according to the number of markers set. Setting a plurality of markers will also make it possible to resume printing from any desired marker by, for example, specifying whether printing is to be resumed from the most recent marker, the next most recent marker, and so forth. When a plurality of markers is set, it is also possible to assign a number or name to each marker. If each marker is assigned a number, for example, a printing process could target printing from, say, marker "5". Let us assume the following example: a sales receipt, a coupon and a warranty are to be printed, marker "3" is made to precede the sales receipt data, marker "5" the coupon data and marker "1" the warranty data. If marker "5" is designated, marker printing as the selected resumption operation will resume operation with printing the coupon and then the warranty. Note that designation of a particular marker is possible even during the off-line state by means a so-called real-time command. A real-time command is a command that is directly interpreted and processed without or before being stored in the receive buffer. Therefore, real-time commands can be processed even while the printer is in the off-line state. Various known methods can be used to direct the printing process as the number of markers is increased.

[0049] Since the printer definitions are stored in a marker definition data storage area, the printer definition command(s) for setting printer definitions used for a plurality of receipts in common need only be output once.

[0050] It should be noted that the capacity of the receive buffer 104 is typically significantly greater than the amount of data printed on a single receipt. In this preferred version of the present invention, for example, the capacity of receive buffer 104 is 4 kilobytes while the data printed on one receipt typically occupies no more than 400 bytes. In such cases, the markers are rarely overwritten.

[0051] Marker validity is determined in this preferred embodiment by detecting whether a set marker command (ESC B) is stored at the address indicated by the marker pointer, but other methods can be alternatively used. For example, the data storage address and the address indicated by a marker pointer can be compared each time data received from the host is stored in the receive buffer 104. If the data storage address exceeds the address indicated by a marker pointer, the marker is determined invalid, and the marker pointer is set to null. If the marker printing process detects a marker pointer of value null, a marker error is sent to the host 102.

[0052] The printer re-initialization command and the re-initialization printing process are described next below.

[0053] The processes executed in response to a printer re-initialization command and the re-initialization printing process are similar to the marker registration and marker printing process, respectively, described above. The differences are as follows. The set marker command *(ESC B)* causes the current printer definitions to be saved so that the printer can be reset to the previous settings based on the saved printer definitions when the printer resumes operation. With the printer re-initialization command *(ESC C),* however, the printer definitions are not saved. Instead, in the re-initialization printing process the printer definitions are returned to the default printer definitions, and the print buffer 107 is cleared. Thus, there is no need for a marker pointer storage area or a marker definition data storage area. The printer re-initialization command is therefore particularly suitable for a printer having a limited storage capacity.

[0054] When the command *ESC C is* received from the host, the printer 101 stores the command as a in the receive buffer 104. When the command is detected during command processing, the printer sets the printer definitions to default settings and clears print buffer 107.

[0055] When re-initialization printing is performed, the receive buffer 104 is searched from the end to the start for an address at which *ESC C* is stored. Data interpretation, print data generation and printing processes are then resumed from the address at which *ESC C* was found.

[0056] Since data interpreting begins with the address at which the *ESC C* command is found, *ESC C* will be interpreted first. As a result, the printer definitions are restored to the default settings, and the print buffer 107 is cleared. Normal data processing proceeds thereafter with the data following *ESC C* in receive buffer 104..

[0057] As described above, this preferred embodiment searches for an address at which *ESC C* is stored by proceeding from the end to the start of receive buffer 104, and returns the first address that is found, if any, as the search result. Alternatively, the search could proceed from the start to the end of receive buffer 104, including address areas containing data that has already

setting the printer according to the settings information stored by said marker means.

5. The printer as set forth in claim 3 or 4, further comprising notification means for notifying the host device of an error if in the process of the preselected resumption operation said particular position in the buffer (104) is not detected.

6. The printer as set forth in claim 2 or claim 2 and claim 3, 4 or 5, further comprising notification means for notifying the host device if as the result of the preselected resumption operation the data in said buffer (107) are cleared.

7. A method of controlling a printer, comprising:

(a) receiving print data and control commands from a host device(102);
(b) storing received print data and control commands in a buffer (104);
(c) performing printing based on print data and control commands stored in said buffer; and
(d) detecting a first predetermined one among said control commands;

characterized by

(e) preselecting, in response to a detection in step (d), one out of a plurality of resumption operations to be performed when the printer resumes operation upon recovering from an off-line state; and
(f) performing the preselected resumption operation when the printer resumes operation upon recovering from the off-line state.

8. The method as set forth in claim 7, wherein said plurality of resumption operations includes one or more of the following operations:

- restarting printing from the start of an area that was being printed when the printer went off-line,
- continuing the command execution process, if nay, that was being performed when the printer went off-line,
- clearing print data and command data in said buffer, and
- stopping the command execution process, if any, that was being performed when the printer went off-line.

9. The method as set forth in claim 7 or 8, further comprising

(g) detecting a second predetermined one among said control commands; and

(h) storing, in response to a detection in step (g), information specifying a particular position in said buffer (104),

wherein said plurality of resumption operations includes

(i) printing from the print data or control command stored at said particular position in the buffer.

10. The method as set forth in claim 9, wherein step (h) includes

(j) storing the current printer settings information,

wherein said plurality of resumption operations includes

(k) resetting the printer according to the settings information stored in step (j).

11. The method as set forth in any one of claims 7 to 10, further comprising (l) notifying the host device of the result of the preselected resumption operation.

12. An information storage medium carrying, in machine-readable form, a program for controlling a printer in accordance with the control method as defined in any one of claims 7 to 11.

13. A information processing apparatus connected to a printer as defined in any one of claims 1 to 6 for controlling the printer by sending thereto data including print data and control commands, comprising:

a transmitter for sending a command which requires the printer to perform printing in accordance with the data stored at a predetermined area in said buffer when the printer resumes operation from an off-line state;
a receiver for receiving from the printer an error notification indicating that information specifying said predetermined area is not contained in the buffer; and
re-sending means for resending print the data corresponding to the data stored at the predetermined area in the buffer when the receiver receives the error notification from the printer.

14. A control method for an information processing apparatus connected to a printer for controlling the printer by sending thereto print data and control commands, comprising:

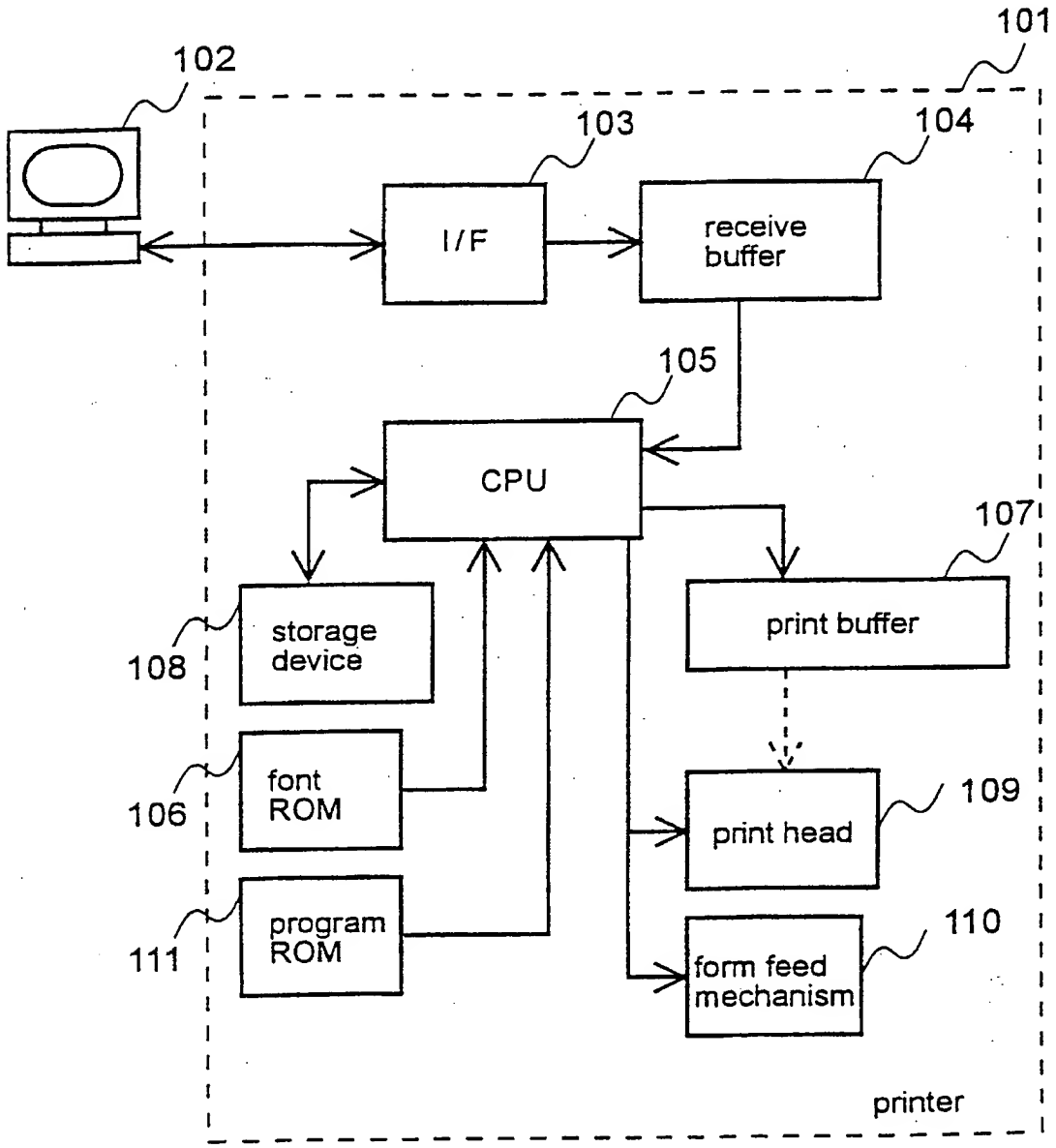
101
102
103
104
I/F
receive buffer
105
CPU
107
print buffer
108
storage device
106
font ROM
109
print head
111
program ROM
110
form feed mechanism
printer

FIG. 1

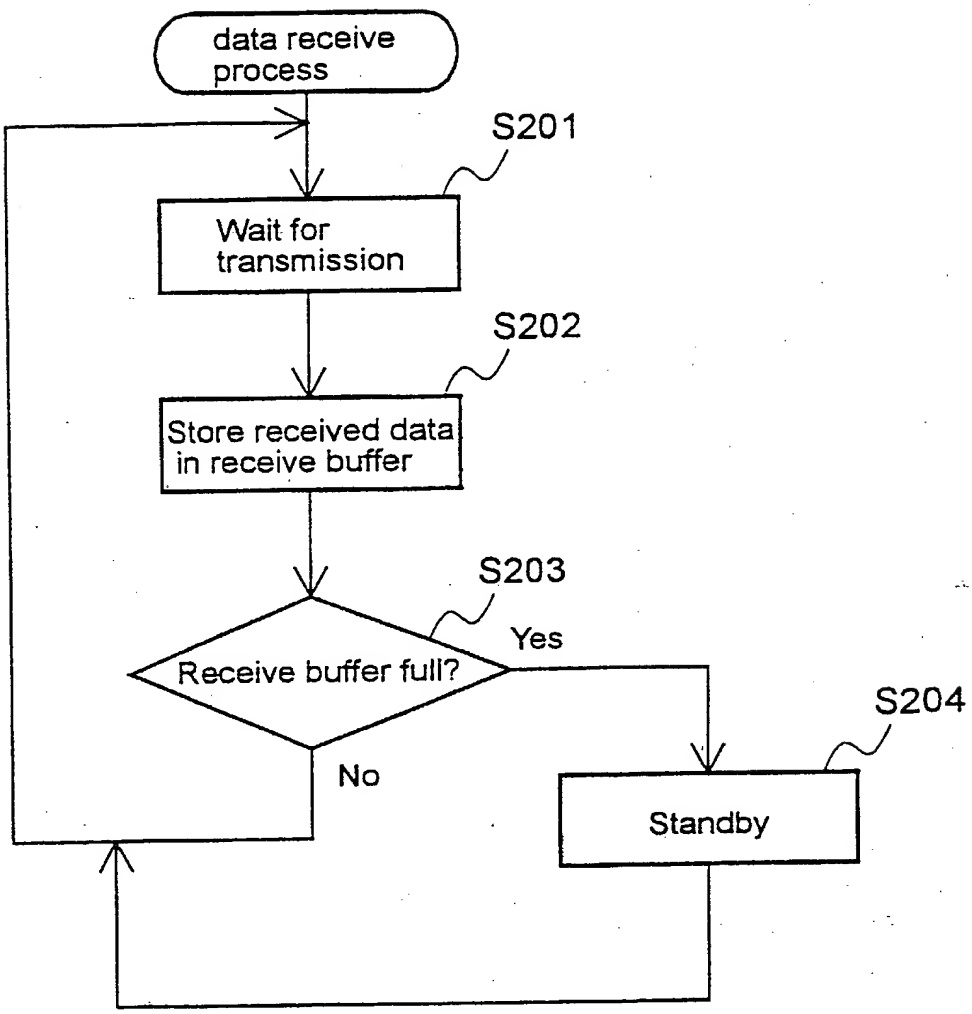
data receive process
S201
Wait for transmission
S202
Store received data in receive buffer
S203
Receive buffer full?
Yes
No
S204
Standby

FIG. 2

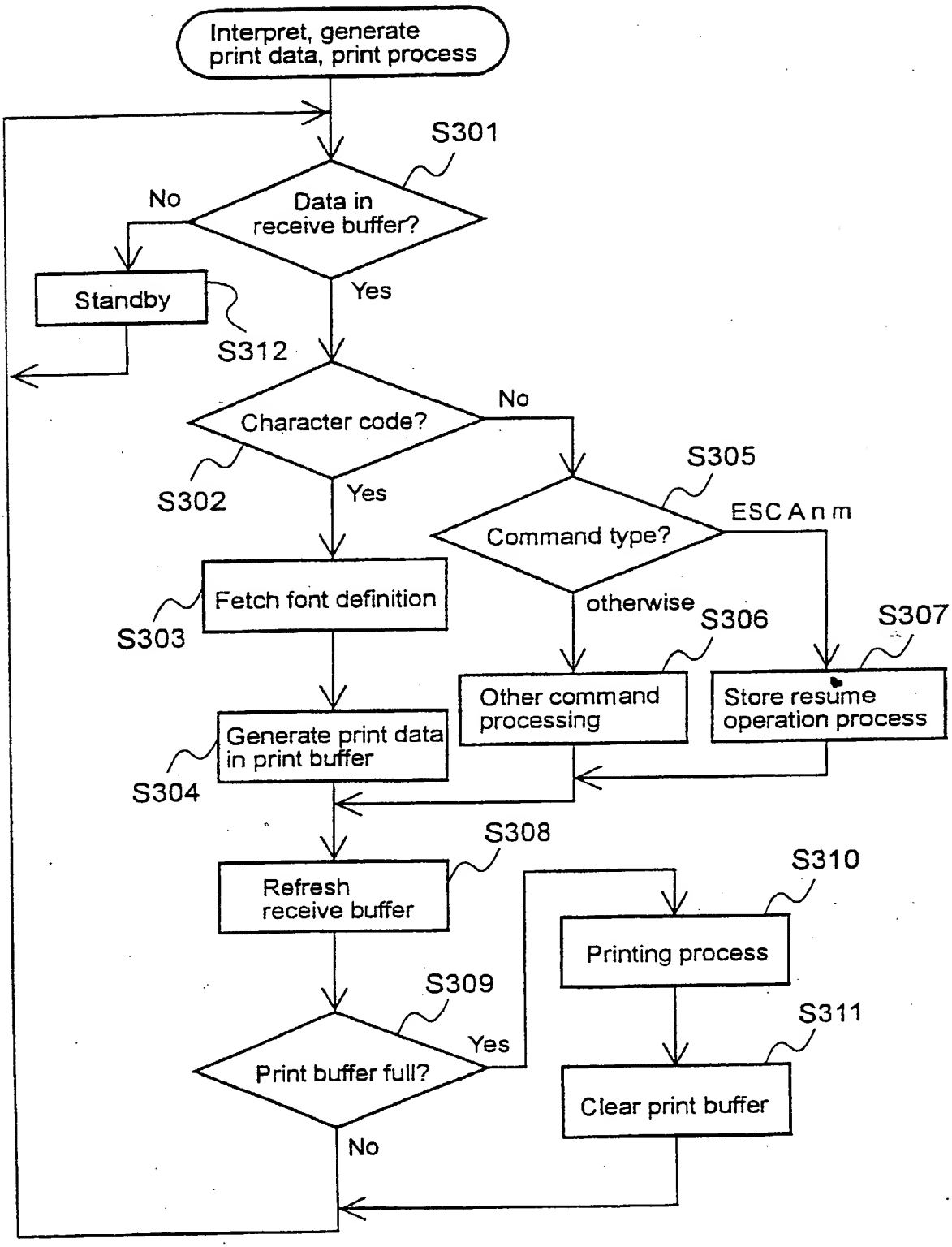
Interpret, generate print data, print process
S301
Data in receive buffer?
No
Yes
Standby
S312
Character code?
No
Yes
S302
S305
Command type?
ESC A n m
otherwise
Fetch font definition
S303
S306
S307
Other command processing
Store resume operation process
Generate print data in print buffer
S304
S308
Refresh receive buffer
S310
Printing process
S309
Print buffer full?
Yes
S311
Clear print buffer
No

FIG. 3

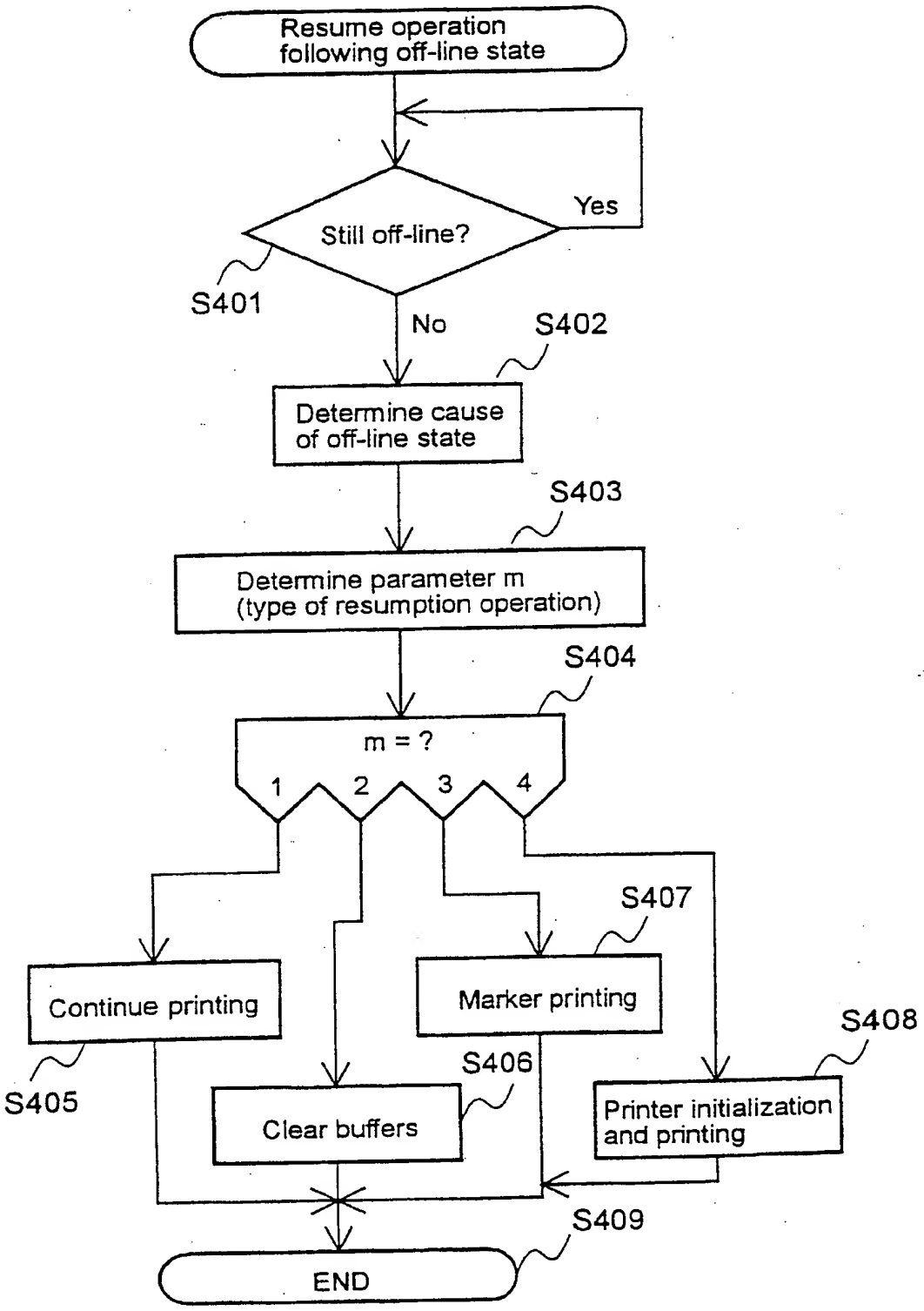
Resume operation following off-line state
Still off-line?
Yes
No
S401
S402
Determine cause of off-line state
S403
Determine parameter m (type of resumption operation)
S404
m = ?
1
2
3
4
S407
Continue printing
Marker printing
S408
S405
S406
Clear buffers
Printer initialization and printing
S409
END

FIG. 4

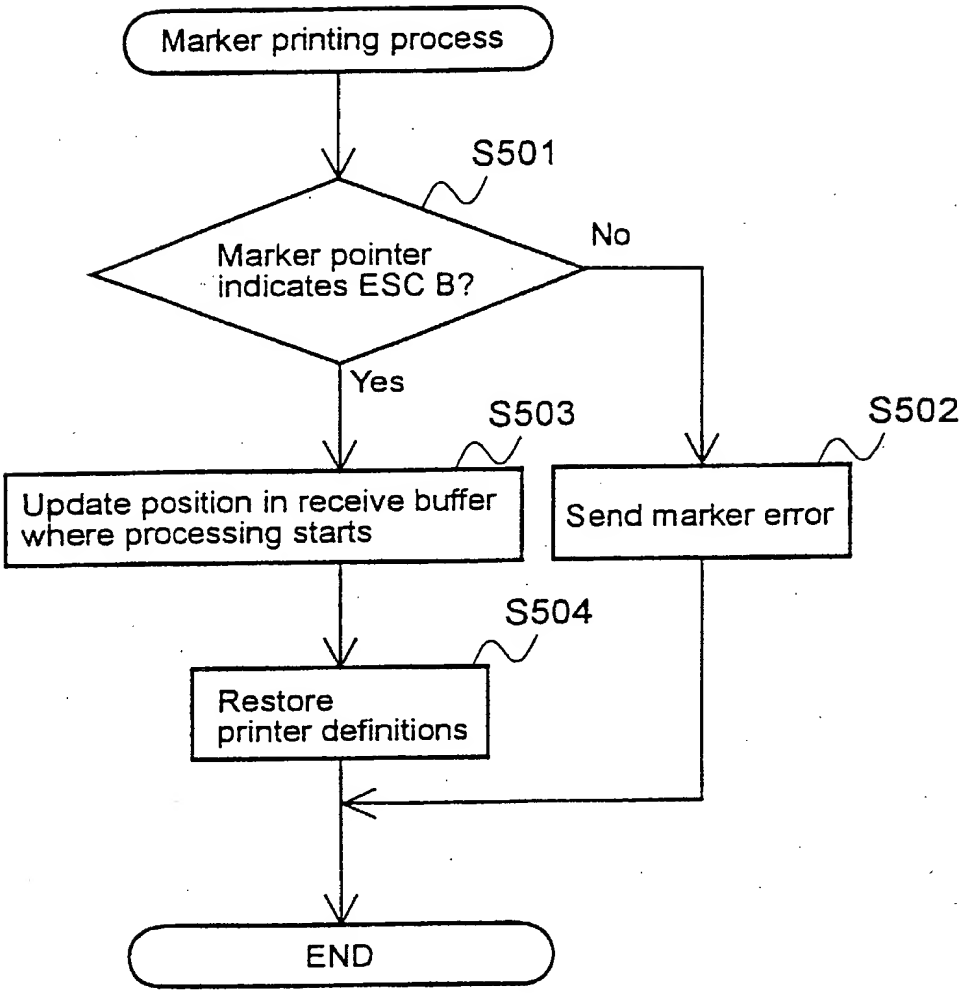
Marker printing process
S501
Marker pointer indicates ESC B?
No
Yes
S503
S502
Update position in receive buffer where processing starts
Send marker error
S504
Restore printer definitions
END

FIG. 5